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Physical & Applied Sci. Serials

UNIVERSITY OF TORONTO
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Fortieth Annual Report of the Savilian Professor of Astronomy to the Visitors of the University Observatory for 1914–15.

BOARD OF VISITORS, 1915.

THE VICE-CHANCELLOR (Thomas Banks Strong, D.D., Dean of Christ Church).
THE SENIOR PROCTOR (Edward Hilliard, M.A., Fellow and Tutor of Balliol).
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THE ASTRONOMER ROYAL (Sir Frank W. Dyson, M.A., LL.D., F.R.S.).
THE DIRECTOR OF THE CAMBRIDGE OBSERVATORY (Professor A. S. Eddington, M.A., M.Sc., F.R.S.).
THE RADCLIFFE OBSERVER (A. A. Rambaut, M.A., D.Sc., F.R.S.).
EDWIN B. ELLIOTT, M.A., F.R.S., Fellow of Magdalen. } For ten years until
CHARLES LEUDESDORF, M.A., Fellow of Pembroke. } Nov. 10, 1915.
WILLIAM ESSON, M.A., F.R.S., Fellow of New College. } For ten years until
SIR W. H. M. CHRISTIE, K.C.B., Hon. D.Sc., F.R.S. } Nov. 10, 1920.

THE Report here presented refers to the period from April 26, 1914 to April 25, 1915, and exhibits the state of the Observatory on the last-named day. It is arranged in conformity with the report on the form of Reports presented on Oct. 25, 1913.

Attention may be specially drawn to the promised benefaction of the Rev. T. E. Espin of Exeter, mentioned in the concluding paragraph.

I. Staff.

First Assistant. Mr. F. A. Bellamy, Hon. M.A., who has general charge of the work under the Director and represents the Director in his absence. His service dates from 1892.

Second Assistant. Mr. R. S. Capon, B.A., St. John's, was given a year's leave of absence last July in order that he might avail himself of an opportunity very kindly put at his disposal by Professor G. E. Hale to work for one year at the Mount Wilson Observatory. He had of course not long arrived when war was declared. He at once volunteered for service to the British Consul in California, but there were apparently difficulties and delays in accepting such offers; on January 16 he returned to England and in February joined the Artists' Rifles (3/28 Batt. London Regt.). In spite of these untoward circumstances, he worked hard at Mount Wilson; and Prof. Hale has written in very favourable terms about his brief period of service there. The post of Second Assistant must be regarded as vacant till the end of the war.

Assistant. Miss E. F. Bellamy, who began work in the Observatory in 1899 was formally appointed Assistant in 1912. Among other duties she superintends the reductions of the Vatican plates and has charge of the clock comparisons.

Caretaker. Mr. J. Mullis, whose service dates from 1874, has recently been feeling the effects of age and infirmity; but it seems undesirable to make any change just at present. He was absent through illness from July 23 to October 2, and for various smaller periods.

Computer. Mr. S. Ingles left on July 18, 1914, to take up work in Ceylon. The office has not since been filled.

It will be seen that, with no Second Assistant or resident Computer, and with Mr. Mullis working under disabilities, a great deal of extra care and trouble has been thrown on Mr. and Miss Bellamy, and the cordial thanks of the Director are due to them for the cheerfulness with which they have responded.

At the suggestion of Miss E. R. Price and Mrs. Bourne (members of the Citizens' Emergency Committee) several of the Belgians at present resident in Oxford have, since March 22, been measuring star photographs at the Observatory, as volunteer work.

Mr. R. Allen, with the assistance of Mr. E. Percy as scribe, has completely measured a plate for proper motions (175 stars, 15 years' interval) and made 1,000 other measures on another plate. He had had some previous experience of the use of a microscope.

MM. F. and G. Ribaucourt, M. T. de Reul, and M. E. Nys have had to begin from first principles but are already doing good work. The scope of this piece of international work has of course been explained to them, and they all show great interest in it. M. de Reul has also assisted with measuring and with the simple counting of stars of various magnitudes in the printed Oxford Volume V (+27°).

II. Teaching.

The course of lectures by the Professor on the Astronomy required for the Mathematical Final Schools was transferred to the Hilary and Easter Terms, as the date of the return journey from Australia was somewhat doubtful.

The practical instruction has, in the absence of the Second Assistant, been given by the Professor.

On Easter Monday a lecture was given to about 100 Co-operators who were visiting Oxford. One or two lectures were also given to soldiers training in Oxford. The Lecture room was used daily for a considerable period for the instruction of a corps of signallers under Lieut. Ditchburn ; and generally, whenever the use of it was applied for, by those drilling in the Park.

III. Research and Publications.

Part I of Vol. VIII of the Oxford Astrographic Catalogue was distributed last May. The Director acknowledges the courtesy of the Oxford Postmaster in collecting the volumes at the Observatory (a weight of about three quarters of a ton).

Copies of the first volume of the Vatican Zones (Decl. +60°) were received on March 19 last. This volume was printed at Rome ; but the proof-sheets were regularly sent to this Observatory for scrutiny. Sheets for the second volume (+63°) began to arrive on March 9.

The reduction of zone +62°, which was up to R.A. $18^h\,40^m$ at the date of the last report, has been completed. Zone +61° has also been completely reduced during the year; zone +60° is very nearly completed; and the measures for zone +59° are on their way here from Rome. It is a great satisfaction to see this work proceeding so steadily, for some portions of it undertaken in other countries are meeting with distressing delays owing to various causes.

As mentioned in previous reports funds for the computations done under the superintendence of this Observatory are provided by the Vatican, and in spite of political troubles have so far arrived regularly. But there was some anxiety last autumn lest these should fail, which would have meant the stoppage of the work. On mention being made of this anxiety to Professor E. C. Pickering of Harvard, he very promptly made application to the Elizabeth Thompson Fund for aiding research; and as a consequence a sum of £78 has been placed in the hands of the Director as a reserve against contingencies. It is with peculiar pleasure that acknowledgment is made of this piece of international courtesy at such a critical time. The sum has been placed on deposit, and it is hoped to return it untouched at the end of the war, or of the work, as circumstances may suggest; but meanwhile it enables us to proceed in this important enterprise with comparative freedom from anxiety. It may be recalled that at the outset funds were provided by Mr. A. F. Lindemann, F.R.A.S., of Sidmouth; and his generosity is duly acknowledged in the Volume which has just appeared, the cost of the reductions for which was covered by his benefaction.

Oxford has an interest in another of the zones. The Observatory of H.H. the Nizam of Hyderabad undertook a half-share of the zone −17° to −23°, viz. the northern half, −17° to −19° (the other half being undertaken by Santiago in Chile). Mr. R. J. Pocock, B.A., of Queen's, was appointed Director of this Observatory a year ago. He met with various difficulties on his arrival, one of which was that the telescope had been sent by his predecessor to Europe for repair and alteration: more recently he has himself been ill. But he has nevertheless made a successful start and was able to report (dated April 2) that 49 plates (20,000 stars) in zone $-17°$ are now completely measured and reduced, while others are in various stages of advancement.

Another of Mr. Pocock's difficulties, which is also felt elsewhere, is that of obtaining a satisfactory réseau (a series of cross lines accurately ruled on a silver film and used for impressing reference lines on the star photographs). The firm of Gautier in Paris, which has hitherto supplied these réseaux, is unable to undertake such work owing to the war. Various inquiries of English firms led to no satisfactory result. Ultimately Dr. R. T. Glazebrook has most kindly offered to put the resources of the National Physical Laboratory at our disposal for the purpose. A trial ruling has just (April 26) been received from him, and it is hoped that before long the réseaux urgently required for Hyderabad, for this Observatory, and (though less urgently) the Royal Observatory, Greenwich, and perhaps others, may be supplied. Meanwhile recent experience has shown us how much we were indebted, more or less unconsciously, to the firm of Gautier for the excellent work they did at a very moderate cost.

As regards our Oxford portions of the work—having completely published the actual measures some years ago, we entered upon the discussion of the results. After the positions of the reference stars had been discussed and published, it was time to turn attention to the estimates of brightness. A method of investigating these by simple counts was outlined in 1909, and has been applied, to test its general usefulness, not only to the Oxford measures, but to those made at Bordeaux and Algiers in the northern hemisphere, and the Cape of Good Hope and Perth (West Australia) in the southern. Various systematic errors have been clearly demonstrated by the method; and two or three pieces of important information about the stars themselves have been gathered.

(*a*) That the ratio of the number of faint stars to bright is not very different in the Galaxy from the ratio near the poles of the Galaxy. This result as stated in 1909 broke new ground; for though the ratios of the number of faint stars to bright had been studied previously, the estimates of brightness were referred to a visual scale, and photographic measures would not necessarily obey the same laws. Apart from this distinction it was in general agreement with what had been found by Pickering of Harvard, and in contradiction to the conclusions of Kapteyn of Groningen. The Oxford result has recently been confirmed and extended by the photographic researches of Chapman and Melotte at Greenwich.

(*b*) But the ratio of the number of faint stars to bright, though it does not change much with galactic latitude, does nevertheless vary in different parts of the sky. The counts above mentioned indicate certain regions of the sky where the number of faint stars falls off very markedly; and the working hypothesis has been outlined that there is some obscuring matter in these regions.

(*c*) When due allowance is made for the phenomena mentioned under head (*b*), then the ratio does seem to vary a little with galactic latitude. The phenomena (*b*) are large enough to obscure this small systematic change unless they are first eliminated.

To elaborate this preliminary investigation, the Oxford counts are now being completely discussed by means of a card catalogue. Two zones of the Vatican results have also been counted and a third is well advanced.

The periodogram work during the year has been full of interest. It was mentioned in the last report that the statistics of rainfall were being tested for discontinuities. A series of such discontinuities declared themselves at dates separated on the average by about six and a half years; but governed by a systematic cycle of about forty-one or forty-two years. Moreover these dates seem to follow by about a year the epochs of quiescence of the earth's axis of rotation. The cycle of forty-one years has been found by Professor D'Arcy Thompson in tidal observations; and it is shown by records of hard winters. On the other hand it has not so far been found in the interesting data from measures of the rings of tree growth (collected by Mr. A. E. Douglass, and kindly placed at disposal by him) or in the records of Nile flood. Returning to the rainfall statistics, the general result found is that a new chapter in meteorological history is opened at each critical date. Even the semi-annual period in rainfall does not occur as a constant periodicity, but changes in phase, and also slightly in period, at the critical dates. Hence when such series have been tested in the past for permanent periodicities, the response has been confused and uncertain. This work involves great labour, and suggests an almost indefinite extension; but a number of results are now being gathered together for publication. A brief account of some of them was given to the British Association in August last at Sydney.

The Director continues in charge of the Earthquake station at Shide. This has involved a number of periodical visits and a certain amount of extra work: but there are many points of contact between seismology and astronomy; and the work of the Oxford University Observatory might well extend in the direction of Geophysics as that of the Cambridge Observatory has extended in the direction of Astrophysics.

The following papers, by members of the staff and others, have been published during the year. It will be seen that Miss Blagg has continued her work on Baxendell's *Observations of Variable Stars*, two instalments having been published during the year:—

231. "Baxendell's Observations of Variable Stars. Third Instalment. No. 6, U Cygni; No. 7, R Delphini; No. 8, S Delphini; No. 9, T Delphini." Edited by H. H. Turner and Mary A. Blagg, *Mon. Not. R. A. S.*, LXXIV, p. 568 (May, 1914).

232. "Correction to Note on spectroscopic binaries and the Velocity of Light." By R. S. Capon, *Mon. Not. R. A. S.*, LXXIV, p. 658 (June, 1914).

233. "Note on the Meaning of the so-called third Star Stream Drift 0." By H. H. Turner, *Mon. Not. R. A. S.*, LXXV, p. 2 (Nov. 1914).

234. "A Proposal for the Comparison of the Stellar Magnitude Scales of the different Observations taking part in the

Astrographic Catalogue. Fourth Note: The Cape Magnitudes." By H. H. Turner, *Mon. Not. R. A. S.*, LXXV, p. 57 (Dec. 1914).

235. "Address on Airquakes to the British Astronomical Association." By H. H. Turner, XXV, p. 116 (Dec. 1914).

236. "Reply to Professor Sampson's Objection to the Hypothesis of a Sun-spot Swarm." By H. H. Turner, *Mon. Not. R. A. S.*, LXXV, p. 138 (Jan. 1915).

237. "A Proposal for the Comparison of the Stellar Magnitude Scales of the Observatories taking part in the Astrographic Catalogue. Fifth Note: The Perth (W.A.) Magnitudes." By H. H. Turner, *Mon. Not.*, LXXV, p. 143 (Jan. 1915).

238. "The Number of Stars of Different Magnitudes in the Perth Astrographic Catalogue. Vol. II." By R. J. Pocock, *Mon. Not.*, LXXV, p. 148 (Jan. 1915).

239. "Obituary Notice of Seth Carlo Chandler." By H. H. Turner, *Mon. Not. R. A. S.*, LXXV, p. 251 (Feb. 1915).

240. "Baxendell's Observations of Variable Stars. Fourth Instalment, No. 10, S Geminorum; No. 11, R Herculis; No. 12, S Herculis." Edited by H. H. Turner and Mary A. Blagg, *Mon. Not.*, LXXV, p. 398.

241. "Note on the Comparison of two plates of the same Region in the Vatican Zones of the Astrographic Catalogue." By Ethel F. Bellamy, *Mon. Not.*, LXXV, p. 425.

IV. Buildings.

There is little to report under this head. We are still troubled with a leakage in the Lecture Room, but the Domes remain watertight, since the strips of canvas were applied to the joints. The mention of this expedient in the Report for 1913 has led to its being successfully adopted elsewhere.

The Domes were last painted in 1912 and will require repainting this year.

V. Equipment, Library, &c.

The telescopes are in good order.

The wireless receiving installation was dismounted by officials from the Post Office on the outbreak of war (Aug. 4), and the essential parts sealed up by them in a drawer in the Lecture Room.

The large Simms' micrometer is still in the possession of Mr. J. F. McNeile of Wellington College.

Of the Astrographic Chart 187 more sheets have been received during the year, of which 34 are of regions south of the Equator.

The cutting down and storing of these sheets proceeds as opportunity offers.

The Card Catalogue of pamphlets was completed to date last August.

A number of lantern slides have been made for lecture purposes; and one or two pieces of lecture apparatus have been purchased.

VI. Miscellaneous.

Mr. A. E. Young continued his volunteer work at the Observatory until July 2, 1914. Since the outbreak of war he has been concerned with other matters. His expert advice was of value in May last, when Mr. G. W. Walker visited Oxford in the course of his Magnetic Survey of the British Isles; and officers of the Ordnance Survey attempted unsuccessfully to recover the trigonometrical points in the Park. The establishment of a new mark has now been deferred until after the War.

On the occasion of the Junior Science Club Conversazione on May 26, the Observatory exhibited a number of photographs and pieces of apparatus as on former occasions.

The Director attended the Australian Meeting of the British Association in August last. On the voyage out he visited the Colombo Observatory, by request; and on the voyage home he was enabled by the courtesy of the P. and O. Company to spend eighteen days in India, landing at Colombo from the *Morea*, and re-embarking at Bombay on the *Maloja*. In the interval he visited the Kodaikanal, Madras, and Hyderabad Observatories, and the Meteorological Office at Simla, and had thus opportunities of discussing various projects with the several Directors; among which may be specially mentioned the proposal of Mr. Evershed to make an expedition of several months to Kashmir, in order to test thoroughly its special suitability as a site for a Solar Observatory, which preliminary visits had indicated. News has since been received that a nine months' expedition has been definitely sanctioned and is about to start. The Hyderabad Government had definitely requested a visit for inspection of the Observatory and consultation.

In Australia visits were paid in company with other visiting astronomers to the observatories of Perth, Adelaide, Melbourne, and to Mr. Tebbutt's private observatory at Windsor. The Sydney Observatory is unfortunately at present in a state of suspended animation.

A report deals normally with the past rather than the future; but a very pleasant reference to the future may be made in conclusion. The Rev. T. E. Espin, M.A., F.R.A.S., Vicar of Tow Law, co. Durham, formerly a member of Exeter College, has intimated (in a letter of which copies have been sent to the Vice-Chancellor and to the Rector of Exeter) that he has made provision in his Will that his new Reflecting Telescope, with an excellent 24-inch mirror by Calver, shall be bequeathed at his death to the University, together with an annual salary of £150 to keep an assistant for it. The thoughtfulness of the provision of endowment along with the gift is obvious quite independently of special circumstances connected with Astronomy. But it may be worth recalling here that the establishment of the Isaac Newton Studentships at Cambridge by the late Frank M^cClean have had a remarkable effect in stimulating the study of Astronomy; and it may be confidently predicted that Mr. Espin's benefaction, by providing a permanent opportunity of a similar kind, will be similarly successful. By the courtesy of the Delegates of the Common University Fund such an opportunity has in recent years been provided, but on a more precarious basis. Mr. Espin's own work with his telescopes has been recognized as of the first order: it is sincerely to be hoped that, when at some distant date discontinuity threatens it, his wise provision will avert that calamity.

H. H. TURNER.

UNIVERSITY OBSERVATORY,
OXFORD,
April 29, 1915.